

Seeing without seeing: An MRI for an unborn penguin

By Amy Mast

The Phillips Three-Tesla Whole Body System at the University of Florida's Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) facility is just the right shape to slide a person through. This time, however, the MRI patient in question is small enough to hold in your hand, temperature-controlled, and as well-guarded as a bar of gold.

"This is exploratory I guess, but I hope we see something beautiful," said UF Biochemistry and Molecular Biology Professor Art Edison as the patient was readied for imaging.

An MRI works by using a magnetic field to discern soft tissues of different densities, creating a picture with that information. Without

harming the person or animal, the magnetic field, along with radio waves, interacts with hydrogen atoms inside the body, and the way those atoms react informs the image's content. MRI gives scientists and medical personnel information that can help them to more intimately learn the structure and function of something as small as a mouse brain

or as everyday as an athlete's injured ligament.

Today's patient is a perhaps fertilized king penguin egg, carefully removed from a temperature-controlled cooler called a "Brooder." King penguins, the second-largest of all penguin species and a 250-strong fixture colony at Sea



A Sea World, king penguin eggs are marked and tracked.

World's Orlando location, don't give up their secrets easily. Their eggs are far thicker than the chicken egg you're used to buying at the grocery, both to insulate them from cold and to help them endure the rough-and-tumble life of being sat on by two 30-pound parents. A single king penguin egg typically weighs up to two-thirds of a pound.

This sturdiness serves king penguins well in their sub-Antarctic natural habitat, but it's a frustrating roadblock to caretakers who want to learn more about the animals' development. Typically, to gauge whether a chicken egg is fertilized, you "candle" the egg, or hold a light behind it. Because the shells are translucent, people who raise chickens and other fowl have developed visual clues to identify each stage of development.

For Sea World staff, the same process that's so clearly revealed in a chicken and even in some other penguin species is shrouded in mystery. Caretakers can see only the faintest shadows inside such thick eggs, and must treat many infertile eggs with the same time, care and attention as those 10 or 20 each year that turn into penguins.

"When we candle other eggs, we can see the whole process—the veins starting to develop, the chick movement," explained Sea World staff member and penguin specialist Jill Lewis. "If this imaging process ends up working out,

it would be a nice to learn a little bit more about the stages of development, especially with the king penguin's eggs."

Lewis and others number and date each egg so that the gestation period can be tracked. It typically takes a little under two months from the day the egg is laid until the brown, downy chick hatches.

After the egg is secured in the MRI, the imaging process begins and a ghostly image of the egg appears. Inside, it's shadowy, mostly black. A lone, clearly delineated white curve appears, and the technicians and staff assembled in the room begin to whisper to each other. Is it a spinal column? It's probably not, but that single, knobby curved line is the only sign of life – of structure – to look at.

The penguin egg was also imaged in UF's 4.7 Tesla magnet, which is more powerful than an MRI found in any hospital and can produce a more detailed image than the first machine. The more powerful field requires a smaller space for specimens, so it's used for animal-only imaging. But even with more power, the results are the same – an egg with nothing but shadows inside.

As it happens, penguins don't care about the scientists as much as the scientists care about the penguins. This time around, each of the eggs imaged was infertile or not viable.

With the kings' secrets preserved, staff at Sea World will for now do as they've always done - treat each egg in the temperature-controlled colony as precious and as fertilized, incubating the ones the birds abandon in the hopes of producing a chick until the regular gestation period has passed.

Next time, the team may, through educated guess and luck of the draw, produce a fertilized

egg for imaging. When this happens, they'll use the same MRI machine again. This sophisticated piece of equipment has been used to image everything from human beings to, well, just about everything else.

"We've done a lot of strange imaging before," Edison explained. "We've looked at termite mound formation, large boa constrictors, golden eagles with broken wings. We've looked at manatee parts. We image mostly mice and rats for medical research, but it's nice to get some variety. Actually, we've done a Florida panther in there. I got to touch its paw."



The 4.7 Tesla magnet.

Though the team didn't get the result they were after, both the scientists and the Sea World staff got a reminder that sometimes nature's fickleness can outwit trained experts and the technology they employ. Maybe next time more than that thin white line, curved like the tiniest moon, will be waiting to meet all the curious people eager to see something no eye has ever seen before.



UF Magnet Lab and Sea World staff await imaging results.

THREE LOCATIONS, ONE LAB

The University of Florida's Magnet Lab facility, located in Gainesville, FL, is one of three facilities bearing the Magnet Lab name (the other two are the main location in Tallahassee and the pulsed-field facility in Los Alamos, New Mexico). The **AMRIS Facility** described in this article focuses on ultra-sophisticated imaging, from whole animals all the way down to individual cells, and nuclear magnetic resonance.

The University of Florida's Magnet Lab group also includes the **High B/T Facility**- a research group studying the behavior of matter in high magnetic fields with super-low temperatures. This group works with three interconnected, superconducting magnets and experimental temperatures are so low that even noise is controlled to minimize interference that could raise temperature.

The University of Florida and Florida State are traditionally rivals, but the Magnet Lab partnership has been fruitful for researchers on both sides. "It really is one thing that UF and FSU really work together closely on," said Edison. "We are lucky to have a great relationship, although football season is always exciting."